Cage Fish Culture in Nepal

Rama Nath Sharma
Fisheries Development Section
Department of Agriculture
Nepal

Cage fish culture is a new area of fish culture in Nepal. Fishermen did not know about it although they have been using some cage-like bamboo traps for fishing. Cages for keeping common carp breeders in the Pokhara Valley lakes of Nepal was started in 1972 as the Government fish ponds near the lake suffered occasionally from water shortage. Later, a few cages introduced by the J.O.V.C. Services were used for rearing fish but remain as demonstration-cum-study unit.

In 1975, an Integrated Fisheries and Fish Culture Development Project in the Western Development Region of Nepal was started by the Government and UNDP/FAO. Under the project, many types of cages both locally made and imported ones have been tried in an attempt to increase the fish production from the three major lakes of Pohara Valley. The lakes lie in mid-hilly region and have been reportedly overfished . The primary aim was to engage some 300 landless local fishermen families in fish culture rather than have them fishing only in lakes.

There are eight small lakes in Pokhara Valley. Phewa, Begnas and Rupa lakes comprise about 800 hectares. The rest are small bodies of water. Cage fish culture has been started in the above three lakes through private fishermen and Government efforts.

Construction and Design of Cages

Bamboo cages

Cages from locally available material like chicken wire mesh and split wood were tried. These were set in shallow water about 2-2.5 m deep. These did not work well because of fluctuating lake water level even as the chicken wire mesh started rusting after 6 months only. At present, split bamboo cages with enamel painting are under study. They are of 10 m^3 size (2 x 2 x 2.5 m^3) and 8 m^3 (2 x 2 x 2 m^3) size. Durability tests of such cages with coal tar painting are being planned. The bamboo could last for about 2 years as a float as well as for framing material using knotless polyethylene net.

Iron angle and netlon plastic cage

Iron angles of 13 mm or 19 mm were welded together to form a frame of 4 x 4 x 2.5 m^3 and netlon plastic mesh of 10 mm or 5 mm was fixed with the nylon twines in the angle-iron frame. Four 200-litre empty oil drums were mounted in welded frames to float the cage at a depth of 2 meters making the productive volume of the cage 32 m^3 or 4 x 4 x 2 m^3. The cage was divided into two compartments by a partition of netlon mesh so that fish of different sizes could be kept separately. The cages were provided with a top cover of chicken wire mesh or old nets. Walkways of woods and bamboo were made by fixing them on the drums. The durability of such cages has been estimated to be about 10 years with minor repair and maintenance.

Norwegian type cage

These are made from 15 mm knotless mesh and have a volume of 100 m^3 (5 x 5 x 4 m^3). Supports come from metal horizontal bars which are fixed to verticals arising out of the plastic buoys. The productive underwater volume is 75 m^3 or 5 x 5 x 3 m^3.

Bridport-Gundry cage

They were imported from U.K. in two sizes: 4.5 x 4.5 x 4.75 m^3 of 19 mm mesh with the productive size at about 80 m^3 (4.5 x 4.5 x 4 m^3); and 7.5 x 7.5 x 4.75 m^3 with a productive size of 225 m^3 (4.5 x 4.5 x 4 m^3). These cages could be submerged completely if used in rectangular bamboo frames which also serve as floats. Thus, the need for costly metal bars and synthetic floats could be avoided.

Japanese vinylon net cages

These cages came in 73.5 m^3 (7 x 7 x 1.5 m^3) 50 m^3 (5 x 5 x 2 m^3), and 13 m^3 (3 x 3 x 1.5 m^3) sizes. The mesh bar ranged from 7 mm to 30 mm. They were mounted on rectangular bamboo frames which also serve as floats. These nets are set in shape using stones and iron anchors.

Species used in cage culture

The following species have been cultured in the cages: silver carp, a phytoplankton feeder; grass carp, which is macrophytophagous; common carp, an omnivore; rohu, a column feeder; and bighead, a zooplankton feeder.

Cage culture practices and results

Rupa and Begnas lakes are more productive than Phewa lake. The major species for the first two lakes are silver carp and bighead while grass carp and other major species were cultured in Phewa lake. In some cages, however, common carp alone and common carp in combination with other species were tried.

The feeds given to common carp both in mono and polyculture were of three types: (a) 50 percent wheat flour, 25 percent rice bran and 25 percent mustard oil cake, (b) 25 percent wheat flour, 12.5 percent rice bran and 12.5 percent mustard oil cake with 50 percent cow dung, and (c) 25 percent wheat flour, 12.5 percent rice bran and 12.5 percent mustard oil cake with 50 percent duck litter.

The stocking rate of fish varied from 250 gm to 2,000 gm/m^3 of cage. The common carp cultured alone or in combination gave conversion rates ranging from 7:1 to 25:1. The addition of cow dung or duck manure did not make any significant difference in conversion ratio, although cost could be significantly reduced by their addition. Feed without dung or duck litter costs about Rs. 1.75 per kg while those in which these materials were added cost Rs. 0.88 per kg. There was no objection from the local people to the use of cow dung or duck litter. The production of common carp is not economical as producing a kilogram of it costs Rs. 10 to 42 while its market price is Rs. 10 to 16/kg. Culture of common carp in cages has been discouraged at least until we develop pelleted protein-rich feed. With grass carp, the conversion has been found to vary from 29:1 to 48:1. In the government cages, the stocking was done at 2 to 42 g size fingerlings at the rate of 1-2 kg/m^3. In the case of mixed culture, the number of fish stocked by species was proportionally reduced to the number of fish species added. In case of cages provided to the local fishermen in Phewa lake, grass carp has been the predominant species; very few silver carp, common carp and Rohu have been added. The average stocking size was 30-38 g and stocking density was 0.5 to 1.0 kg/m^3. It took six months to grow 30-38 g grass carp to 300 g or more in the fishermen's cages.

In Begnas and Rupa lakes which are rich in *Microcystis* and *Ceratium,* respectively, the predominant species is silver carp. The stocking size was 46-47 g and stocking density was about 200 to 250 g/m^3, i.e. 4-5 fishes/m^3. The growth of silver carp was found to be four grams per day in Begnas lake; in Rupa lake it was as high as nine grams per day.

A few Rohu *(Labeo rohita)* were introduced in the cages as they were found to clean up the sides of cages thus minimising human labour for cleaning the net cages. The growth of Rohu has been found to be slow compared to other species; they attained 250-350 g in one year.

Economics of cage culture

The experiences gathered after the introduction of cage culture two years ago in Nepal show the following criteria to make this practice profitable:

Selection of cage material and its durability and handling

Location and topography of sites in which to set the cage

Limnology of lake

Biology of species to be cultured and fingerling availability

Availability of appropriate feed components, and the market for fish

The annual expenditures for cage fish culture and the expected return is given in the following table. The figures are specifically for 32 m^3 angle-iron netlon plastic cage set at Phewa lake where grass carp is the predominant species.

Items	Total Cost Rs.	Annual Costs Rs.	Annual Net Production (kg) Rs.	Annual Return Rs.	Net Profit Per year Rs.
1. Total cost of cage	4970	800			
2. Interest		114			
3. Feeds		279			
4. Fingerlings		269			
5. Miscellaneous		241			
Total		1703	236*	3776	2073

*Rs. 16 per kg.

The above case shows a net production of 7.3 kg fish/m^3/year. However, in Begnas and Rupa lakes which are very shallow but productive, culture of the plankton feeders, i.e. silver carp and bighead carp, has obtained yields of 10-12 kg/m^3/year. Obviously, cage culture is more economical in these lakes as supplemental feeding is not needed even as fish growth appears to be better in these lakes than in Phewa lake. Moreover, the labour and time for feeding daily the fish is saved and only the weekly or biweekly checking and cleaning of cages is needed.

Scope

Estimates of possible fish catch from natural fishery of Pokhara Valley lakes (800 ha) vary from 17.2 to 51.1 tons per year. However, the present annual catch is around 20 tons. Fish cultured in cages without feeding use the same food resources as the naturally growing fish. It has been estimated that around 100 tons of fish could be produced from cage culture with supplemental feeding. The following number of cages could be initially introduced in each lake without creating serious biological problems.

The average production per cubic metre has been placed at 10 kg for the above assumption. The number of cages could be gradually increased while carefully monitoring biological conditions.

Cages

The development of cheaper, durable and easy-to-handle types of cages are necessary for cage fish culture extension. The cost analysis of different types of cages is summarized in the following table. Materials like plastic-netlon, nylon cages, ropes, etc., would last for about 10 years; angle-iron, hard wooden strips, floats, etc., 2 to 5 years; and local bamboos coated with paint, 1 to 2 years. Considering these depreciation values, the annual cost for cages has been projected.

Lake	No. of Cages	Cages Per Unit Area	Ave. Vol. Per Cage cu.m.	Total Cage cu.m.	Estimated Production (tons)
Phewa	100	1 per 4 ha	32	3200	30
Begnas	60	1 per 3.2	70	4200	48
Rupa	50	1 per 2.34	35	1750	18
Khaste	15	1 per 0.7	35	525	4
Total	225			9675	100

Type of cage	Dimension (m)	Productive volume (m3)	Annual cost (Rs.)	Cost/m3/yr (Rs.)
1. Angle-iron and netlon plastic (french)	4 x 4 x 2.5	32	800	25.38
2. Norwegian cage with metal frame & float buoys	4.5 x 4.5 x 4.75	80	1052	13.15
3. Japanese nylon cages with local bamboo as float and frame	(a) 7 x 7 x 1.5	73	538	8.19
	(b) 5 x 5 x 2	50	618	12.36
	(c) 3 x 3 x 1.5	13.5	200	14.67
4. Bridport-Gundry (British) with local bamboo float & frame	(a) 5 x 4.5 x 4.75	80	790	9.88
	(b) 7.5 x 7.5 x 4.75	225	1140	5.31

Cages made from locally available materials like Sal wood and bamboo are under study.

It may be noted that the nylon net cages with bamboo as floats and framing material are economical; they have been found to be amenable to easy operations like growth checking, thinning, and harvesting.

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